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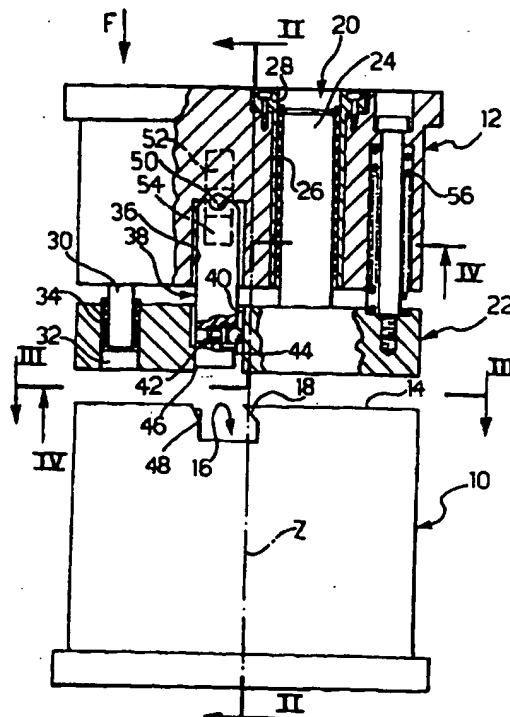
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(54) Title: BENDING APPARATUS FOR METAL SHEETS

(57) Abstract

The apparatus comprises two blocks (10, 12) intended to be associated respectively with the fixed part and with the movable part of a press, to be moved close and moved away mutually. Each block (10, 12) is equipped with a respective blank holder (14, 22). The block (12) contains a blade-carrier body (38) which is movable with the block itself and has a lateral bending blade (44). The blank holder (14) of the other block has a channel (16) in which the end part of the body (38) can be inserted and one side wall of which is shaped like a counterblade (18). The blank holder of the block (12) is in the form of a plate (22) which is slidable in relation to its block in the direction of mutual moving close of the two blocks (10, 12) and is pushed back by resilient means (56) towards the other block to exert a resilient pressure for restraining the piece of sheet (P). The relative arrangement is such that the bending blade (44) does not project in relation to the plate (22) when it is situated in the position of maximum removal from its block (12).



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Bending apparatus for metal sheets

The present invention relates to a bending apparatus for metal sheets and aims to produce a simple and rugged apparatus intended to be installed between two parts, fixed and movable, of a press.

According to the present invention, this aim is achieved by means of an apparatus characterized in that it comprises two blocks intended to be associated respectively with the fixed part and with the movable part of the press to be moved close and moved away mutually, in that each block is equipped with a respective blank holder, the two blank holders facing one another, in that at least one of the blocks contains a blade-carrier body which is movable with the block itself and has a lateral bending blade and the blank holder of the other block has a channel in which an end part of the body which has the blade can be inserted and one side wall of which is shaped like a counterblade with which the blade is capable of interacting, in that the blank holder of the block which contains the blade-carrier body is in the form of a plate which is slidable in relation to its block in the direction of mutual moving close of the two blocks and is pushed back by resilient means towards the other block to exert a resilient pressure for restraining the piece of metal sheet between the two blank holders, and in that the relative arrangement of the blade-carrier body and of the slidable plate is such that the bending blade does not project in relation to this plate when the plate itself is situated in the position of maximum removal from its block.

The invention has been designed in its application to a punching press, illustrated and described in a patent application filed on the same date by the same applicant for a "Method and machine for the production of sheet metal panels", to which reference is made. However, the invention

is not limited to this application and relates to any bending apparatus, as claimed, intended to be installed between two parts, fixed and movable, of a press.

For bending metal sheets, use is made of presses, the blades and counterblades of which have a length which is greater than that of the edge of the maximum length which it is envisaged bending in the press. The result of this is that, for the majority of the time, the press is used below its capacities: it is in fact not rare that a press having a blade and a counterblade of a length of two metres is utilized for bending the edges of plates of sheet metal, the greatest side of which measures much less than one metre.

On the other hand, a manufacturer of panels may find himself in a situation in which he is required to manufacture panels with bent edges, the sides of which measure more than the length of the blades and counterblades of the presses which he has available. This constrains him to equip himself, even if only for occasional work, with a press of a capacity which is greater than that of the presses which he utilizes for his current production, or constrains him to refuse the work which has been ordered from him.

Thanks to the solution proposed by the invention, it is possible to produce a bending apparatus for metal sheets which, as illustrated and described in the above-mentioned patent application of the same date, can comprise at least one bending blade and one counterblade of small length, for example of a few centimetres. In this manner, it is possible to carry out a bend by successive steps or sections, for example by translating a panel of sheet metal by steps along the bending apparatus or vice versa by holding the panel stationary and translating the implement by steps along the bending line. All the relative movements of the tools lend themselves to numerical control to obtain

working cycles which are entirely automated and of great versatility.

As illustrated and described in the above-mentioned patent application of the same date, the bending apparatus can be mounted in a punching press with multiple punches with selective control, as a consequence of the simple substitution of a punch and of the associated die with two opposed tool-holding blocks, one movable and the other fixed.

The invention will be understood more clearly by reading the description which follows, made with reference to the attached drawings which are given by way of non-limiting example and in which:

Figure 1 is a diametral section of a first embodiment of the bending apparatus according to the invention, in a rest state,

Figure 2 is a section thereof made essentially according to the line II-II in Figure 1,

Figure 3 is a plan view according to the line III-III in Figure 1,

Figure 4 is a transverse section made essentially according to the broken line IV-IV in Figure 3,

Figures 5 and 6 are partial sections similar to that in Figure 1, which illustrate on a smaller scale the same bending apparatus in successive phases of an operation for bending an edge of a panel of sheet metal,

Figure 7 is a elevational view in partial section of a second embodiment of a bending apparatus according to the invention, in a rest state, and

Figures 8 to 10 are representations similar to that in Figure 7, which illustrate on a smaller scale the bending apparatus in two successive phases of bending the edge of a panel of sheet metal.

A detailed description of a first embodiment of the apparatus according to the invention will now be made,

first making reference to Figures 1 to 4 and then, to describe the functioning thereof, to Figures 5 and 6.

In all the Figures 1 to 6, the same parts are designated by the same reference numerals.

The apparatus comprises two opposed tool-holding blocks, lower 10 and upper 12.

The lower block 10 is intended to be mounted in a fixed part of a press, for example in a lower die-holding carousel of a multiple-punch punching press.

The upper block 12 is intended to be mounted in a slidable manner, according to a working axis Z, for example in an upper punch-holding carousel of a multiple-punch punching press.

In the case of application to a punching press, the upper block is intended to be associated, for the bending operations, with a thruster above so as to receive a thrust downwards according to the arrows F in Figures 1 and 2.

For all the details of the installation of an apparatus according to Figures 1 to 6, reference is made to two patent applications filed on the same date by the applicant for a "Method and machine for the production of sheet metal panels" and for a "Bending apparatus for metal sheets".

The lower block 10 is constituted by an essentially cylindrical solid body, with an upper face 14 which faces the upper block 12.

The face 14, as will be better understood further on, constitutes a fixed lower blank holder.

An essentially diametral channel 16 is made in the face 14. One side wall of the channel 16 is nose-shaped to constitute a fixed counterblade 18.

The upper block 12 is also constituted by a body which is essentially solid and of essentially cylindrical external shape, and has a longitudinal cylindrical cavity 20.

Associated with the block 12 is a slidable plate, which is situated on the side turned towards the surface 14 of the lower block 10 and serves as upper blank holder.

To allow its sliding in relation to the block 12, the plate 22 has an upper cylindrical end piece 24 which is mounted slidably in the cavity 20 by means of a ball bushing 26 and a sleeve 28.

To prevent the rotation of the plate 22 in relation to the block 12, a guide pin 30 projects from the block 12 at the bottom, which pin extends in a corresponding cylindrical cavity 32 of the plate 22, with the interposition of a ball bushing.

An essentially diametral blind cavity 36 is formed in the body 12, which opens in a position facing the channel 16.

A blade-carrier body 38 is suspended in the cavity 36.

The slidable plate 22 has an essentially diametral through-opening 40 aligned on the one hand with the cavity 36 and on the other hand with the channel 16.

A lower part of the blade-carrier body 38 extends through the through-opening 40, where it is guided, in relation to the plate 22, by means of a resilient tappet 42.

On the side turned towards the counterblade 18, the lower end of the blade-carrier body 38 has a bending blade 44.

On the opposite side, the lower end of the blade-carrier body 38 has a rounded edge 46.

In the region of the edge 46, the side wall of the channel 16 opposite the counterblade 18 has a ramp surface 48 with which the rounding 46, as will be seen, is intended to interact in the manner of a follower surface.

At its upper end, the blade-carrier body 38 has its fulcrum about an axis of oscillation parallel with the blade 44. In particular, for its oscillating suspension,

the body 38 is equipped with a pin 50 fixed to the body 12 by means of fixed brackets 52 and on which the body 38 is suspended by means of oscillating brackets 54.

The plate 22 is pushed back towards the lower block 10 by resilient means constituted by a pair of compression springs 56.

An operation for bending an edge of a panel or plate of sheet P will now be described, making reference to Figures 5 and 6.

In Figures 5 and 6, the execution of a downward, so-called "negative", bend has been represented, but, by arranging the apparatus in an upturned position in relation to that in Figures 1, 5 and 6, a bend of the same type could be made upwards.

In Figure 5, the thruster of the punching press has carried out on the upper block 12 a thrust descending according to the arrow F, making it descend to the point at which the upper blank holder 22 has come to be applied resiliently, as a consequence of a light compression of the springs 56, on the sheet P, pinching it between itself and the lower blank holder 14.

The blade-carrier body 38 has maintained the relative position in Figure 1 and its blade 44, which is situated in line with the lower end of the opening 40, has come to be placed on the edge to be bent of the sheet P.

In Figure 6, the descent of the upper block 12 is continued, according to the arrow F, under the thrust of the thruster of the punching press.

The upper blank holder 22 has remained still against the sheet P while the upper block 12 has descended further against the force of the springs 56. The blade-carrier body 38 has descended further together with the upper block 12 and its lower end, with the blade 44, has penetrated into the channel 16, with the consequent interaction of the blade 44 with the counterblade 18.

During the movement of descent of the blade-carrier body 38, its follower surface constituted by the rounding 46 has engaged the associated ramp surface 48 with a consequent progressive moving of the active edge of the blade 44 close to the counterblade 18 (towards the right in the figures), which has contributed to the execution of a correct bend.

In Figure 6, a 90° bend has been represented, but the descent of the block 12 could have been stopped before the lowered position in Figure 6 to execute a bend with a dihedral angle smaller than 90°. Thus also, bending of the edge of the sheet P could continue beyond the right angle with a further descent of the block 12 and of the blade 44 to a position below the counterblade 18, within the limits allowed by the geometry of the latter.

The apparatus shown in Figures 1 to 6 lends itself to bending the edge of a sheet by successive segments or sections, as described in the patent application filed on the same date by the applicant for a "Method and machine for the production of sheet panels". To this end, as illustrated in Figure 5, the end edges of the blade 44 are beveled, as indicated at 44a in Figure 4.

The second embodiment of the bending apparatus, illustrated in Figure 7 and following, will now be described.

In Figure 7, the parts which are similar to those of the first embodiment are designated as far as possible by the same reference numerals incremented by 100. Certain numbered parts will not be described for brevity, it being understood that their form and their function are similar to those of the same parts indicated by the same reference numerals, not incremented by 100, in Figures 1 to 6.

The lower block 110 is in the form of a cup with a cavity which contains bending equipment like that of an embodiment described and illustrated in the patent

application filed on the same date by the same applicant for a "Bending apparatus for sheets". For all the details of this equipment, reference is made to the contents of this application.

Situated in the cavity of the block 110 is a blade-carrier body 60 with an upper part which extends through an opening 62 made in an upper transverse covering wall 64 of the block 110.

The blade-carrier body 60 has a bending blade 64.

The upper face, designated by 114, of the plate 60 has a channel 116 which is entirely similar to the channel 16 in Figures 1 to 6 and has a similar function with regard to the blade 64.

The slidable plate 122 above, entirely similar to the plate 22 in Figures 1 to 6, has in turn a channel 68 which lies above the through-opening 62 and the blade 66.

One side wall of the channel 68, on the side of the blade 66, has a nose 70 which serves as a counterblade.

Situated in the cavity of the block 110 is a return member in the form of a rocker 72. A lower part of the blade-carrier body 60 engages an arm of the rocker 72, while the other arm of the rocker 72 is engaged by a tappet 74 in the form of a plate, guided in a slidable manner in an opening 76 of the covering plate 64.

The tappet plate 74 is situated below a pin 130, entirely similar to the pin 30 in Figures 1 to 6.

The pin 130, which is integral with the upper block 112, constitutes a moving member which, when the upper block 112 descends, engages in a thrusting manner the tappet 74, making the rocker 72 rotate and thus raising the blade-carrier body 60, the blade 66 of which comes to interact with the counterblade 70.

In this manner, the apparatus in Figure 7 makes it possible to execute in a plate of sheet an upward, so-called "positive", bend, the whole as illustrated and

described in greater detail in the patent application filed by the applicant on the same date for a "Bending apparatus for metal sheets".

The apparatus in Figure 7 incorporates equipment similar to that of the first embodiment in Figures 1 to 6, for executing downward, so-called "negative", bends.

To this end, the upper block 112 has a transverse cavity 136 which is open towards the bottom and aligned with a transverse through-opening 140 of the sliding plate 122. The blade of the blade-carrier body 138 is designated by 144 and is intended to interact with a counterblade 118 constituted by a nose-shaped part which defines a corresponding side wall of the channel 116.

The blade-carrier body 138 is articulated to an upper transverse pin 150 similar to the pin 50 in Figures 1 to 6. The pin 150 is suspended on a slide 152 which can slide vertically in an upper part of the cavity 136.

The slide 152 is suspended in turn by resilient means in the form of one or more traction springs like 154 which ensure that all the equipment constituted by the blade-carrier body 138, by its pin 150 and by the slide 152 is restored upwards to an inactive position.

The slide 152 has an upper rounded wedging surface with which a corresponding oblique wedging surface of a bolt 156, which is slidable transversely in the upper block 112, is engaged.

The bolt 156 can be actuated in a reciprocating manner by means of a hydraulic or pneumatic actuator 158 fixed laterally on the upper block 112.

The arrangement is such that when the bolt 156 is retracted towards the actuator 158, as in Figure 7, with the descent of the upper block 112, the blade-carrier body 138 does not descend below the lower surface of the slidable plate 122, as a result of which the upper blade 144 remains permanently withdrawn in relation to the plate

122 and does not act. This makes it possible to use the apparatus for executing "positive" bends by means of the blade 66 and of the counterblade 70, as described above.

When, on the other hand, it is a "negative" bend which is desired, by means of the actuator 158, the bolt 156 is made to advance (towards the left in the figures) as far as an active position illustrated in Figures 8 to 10. As a consequence of this advance of the bolt 156, the slide 152 and the blade-carrier body 138 are blocked in a lowered active position, in which they are solid with the upper block 112, so that, with the descent of the latter, the blade 144 descends into the cavity 116 and executes a bend in interaction with the counterblade 118.

In Figure 9, the situation is illustrated in which the edge to be bent of a plate or panel of sheet P has been pinched between the two blank holders constituted by the upper face 114 of the plate 64 and by the upper plate 122 and the blade is situated in incipient engagement with the edge to be bent of the sheet P.

In Figure 10, the upper block 112 has descended further and the blade 140, in interaction with the counterblade 118, has carried out a right-angled bend, in the same manner described with reference to Figures 5 and 6.

Naturally, the "negative" bends executed with the blade 144 and the counterblade 118 can have obtuse or even acute angles, as described previously for the embodiment in Figures 1 to 6.

As will be noted, in Figure 10, the pin 30 has made the tappet 74 descend and therefore, by means of the rocker 72, has made the lower blade-carrier body 60 and its blade 66 ascend to the active position of interaction with the counterblade 70. This movement has no effect, however, since, in the execution of a "negative" bend, the panel P is not situated in the zone of the blade 66 and of the

counterblade 70.

The two blade-counterblade pairs 66-70 and 118-144 lend themselves to use in succession for executing S-shaped or Z-shaped bends in one and the same edge of a plate of sheet.

In this case also, the bending operations can take place by successive steps or lengths along an edge of a plate or panel of sheet.

CLAIMS

1. Bending apparatus for metal sheets, intended to be installed between two parts, fixed and movable, of a press, such as a punching press, characterized in that it comprises two blocks (10, 12; 110, 112) intended to be associated respectively with the fixed part and with the movable part of the press to be moved close and moved away mutually, in that each block (10, 12; 110, 112) is equipped with a respective blank holder (14, 22; 114, 122), the two blank holders facing one another, in that at least one of the blocks contains a blade-carrier body (38; 138) which is movable with the block itself and has a lateral bending blade (44; 144) and the blank holder of the other block has a channel (16; 116) in which an end part of the body (38; 138) which has the blade (44; 144) can be inserted and one side wall of which is shaped like a counterblade (18; 118) with which the blade is capable of interacting, in that the blank holder of the block (12; 112) which contains the blade-carrier body (38; 138) is in the form of a plate (22; 122) which is slidable in relation to its block in the direction of mutual moving close of the two blocks and is pushed back by resilient means (56; 156) towards the other block to exert a resilient pressure for restraining the piece of metal sheet (P) between the two blank holders (14, 22; 114, 122), and in that the relative arrangement of the blade-carrier body (38; 138) and of the slidable plate (22; 122) is such that the bending blade (44; 144) does not project in relation to this plate when the plate itself is situated in the position of maximum removal from its block (12; 112).

2. Apparatus according to Claim 1, characterized in that the movable plate (22; 122) has a through-opening (40; 140) through which the blade-carrier body (38; 138) extends.

3. Apparatus according to Claim 1 or 2, characterized in that the blade-carrier body (38; 138) is fulcrumed in the

associated block (12; 112) about an axis parallel to the blade (44; 144) so as to be capable of oscillating towards the associated counterblade (18; 118) and in the opposite direction, and in that, in a position opposite the counterblade (18; 118), the channel (16; 116) of the other block (12; 112) has a ramp surface (48; 148) and the blade-carrier body (38; 138) has a dorsal follower surface (46; 146) which interacts with the ramp surface, these surfaces being arranged so as to transform a course of progressive moving close of the two blocks into a course of progressive moving of the blade (44; 144) close to the counterblade (18; 118).

4. Apparatus according to any one of the preceding claims, characterized in that the blade-carrier body (38) is fulcrumed within the associated block (12) at one end of the block itself opposite the blade (44) and about an axis parallel to the blade, which axis is fixed in relation to the block.

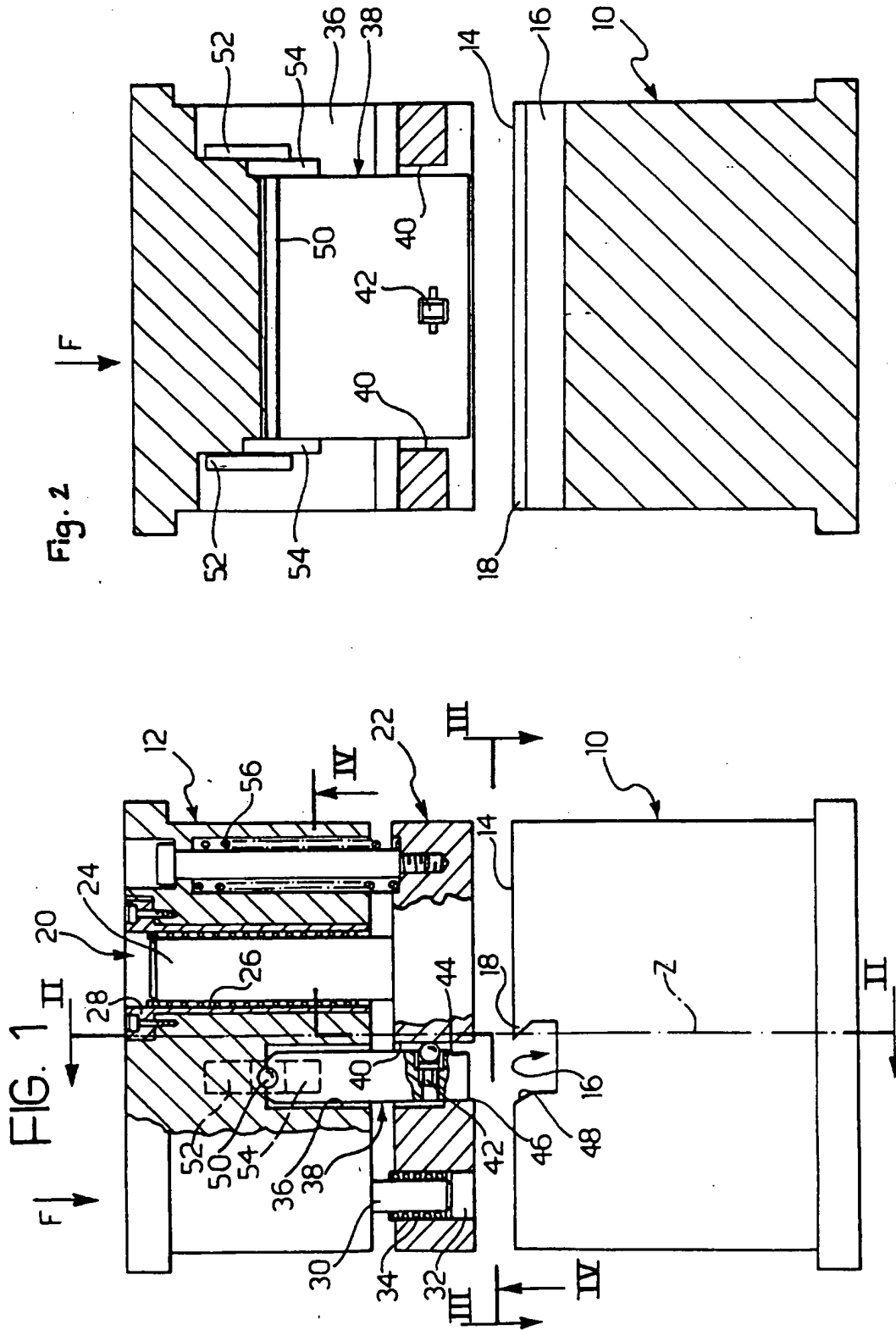
5. Apparatus according to any one of Claims 1 to 3, characterized in that the blade-carrier body (138) is slidable in the associated block (112), in the above-mentioned direction of moving close and moving away of the two blocks (110; 112), between a stable active position, in which the blade (138) is capable of interacting with the counterblade (118), and a stable inactive position, in which the blade (138) is permanently withdrawn in relation to the associated blank holder (122), and in that means (154, 156) of selective retention of the blade-carrier body in both the active and inactive positions are provided.

6. Apparatus according to Claim 5, characterized in that the means of retention of the blade-carrier body (138) in the inactive position are constituted by resilient restoring means (154) and the means of retention of the blade-carrier body (138) in the active position comprise a bolt (156) which is displaceable transversely in relation

to the direction of sliding of the body (138).

7. Apparatus according to Claim 6, characterized in that, in the block (112) containing the blade-carrier body, a slide (152) in engagement at its tip with the end of the body opposite that which has the blade (144) is mounted slidably, in the above-mentioned direction of moving away and of moving close of the two blocks, by means of a fulcrum (150) with an axis parallel to the blade, and in that the bolt (156) and the slide (152) have respective wedging formations for selectively blocking the slide (152) and the blade-carrier body (138) in the active position.

8. Apparatus according to Claim 6 or 7, characterized in that the bolt (156) is displaceable by means of an associated actuator (158).



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FIG. 3

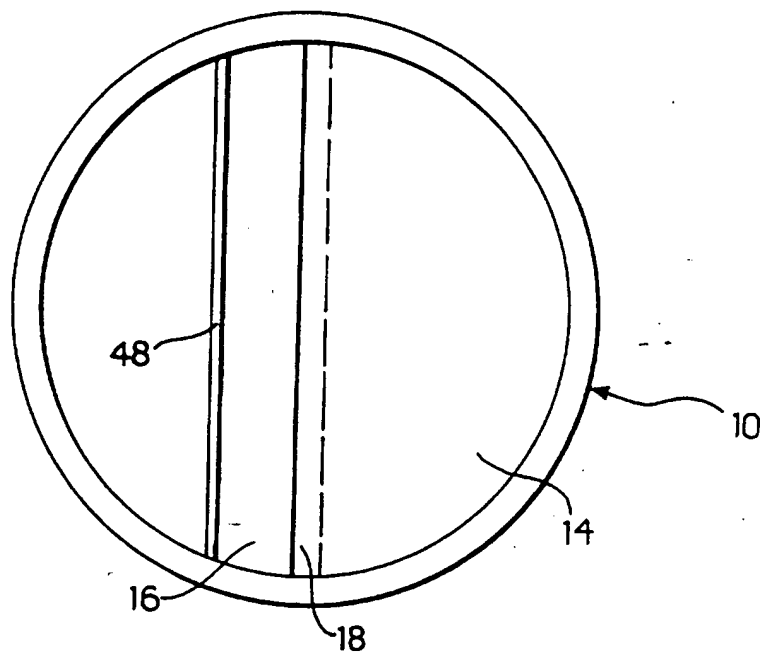
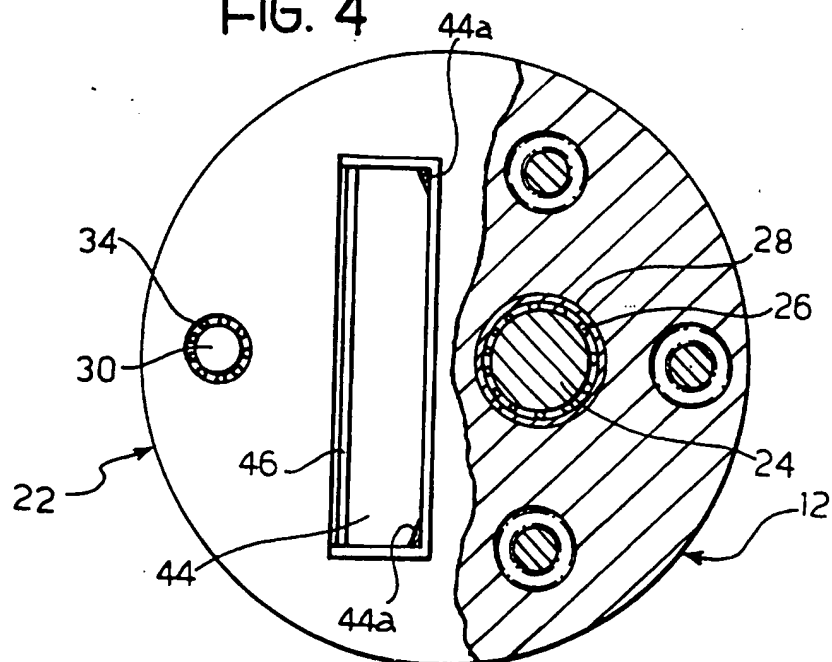


FIG. 4



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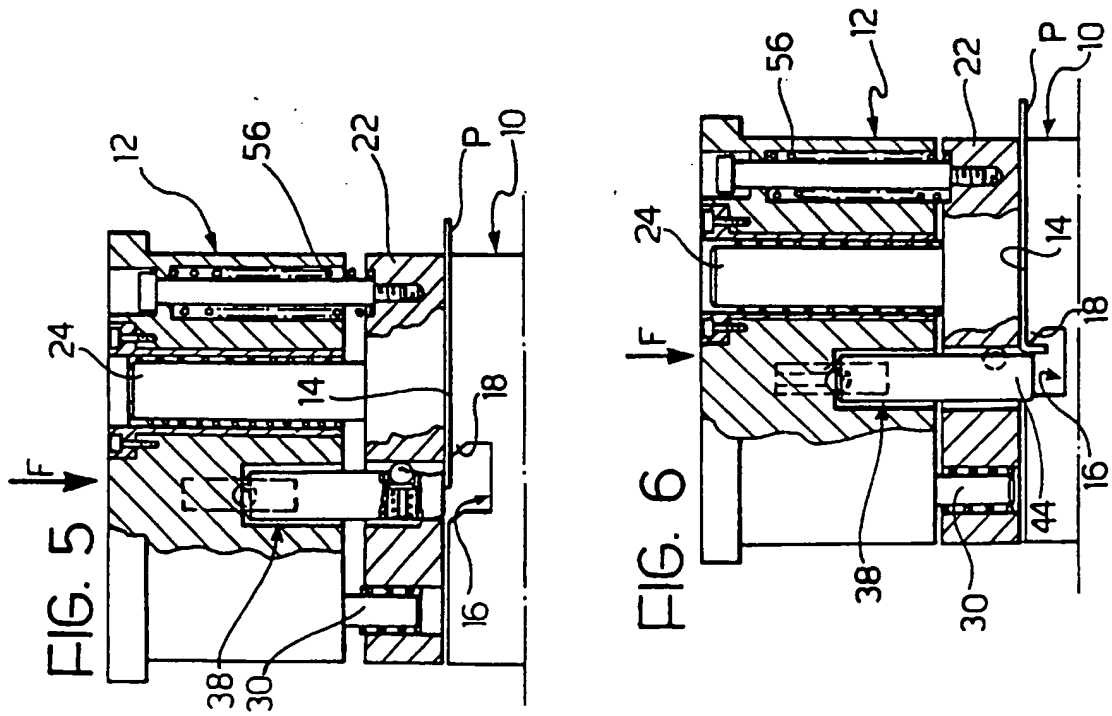
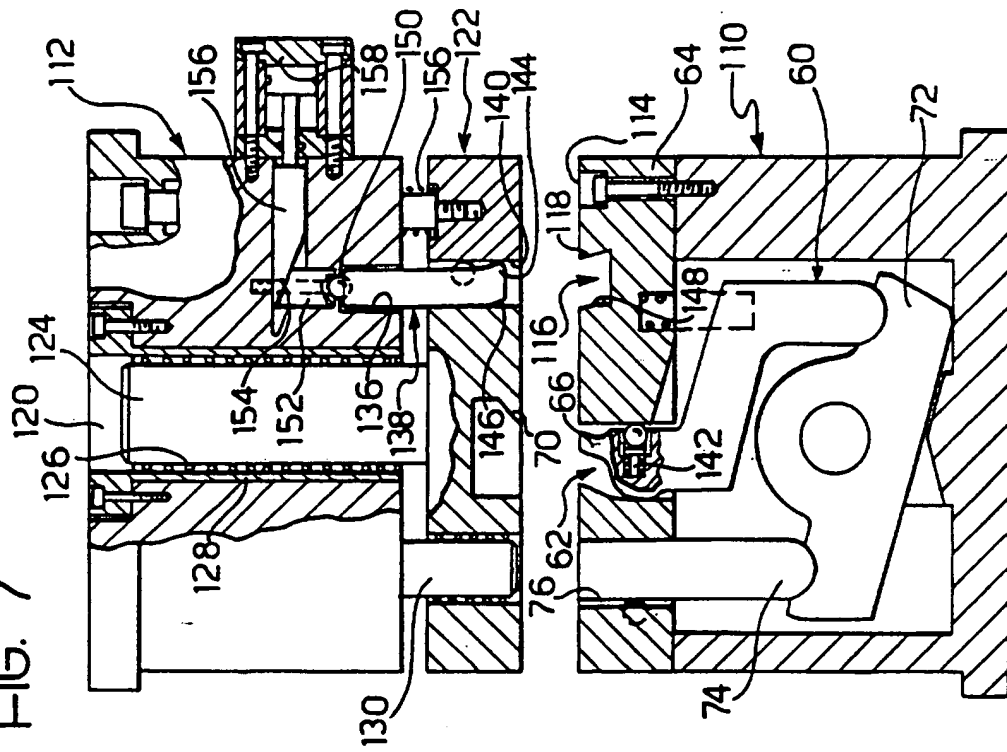
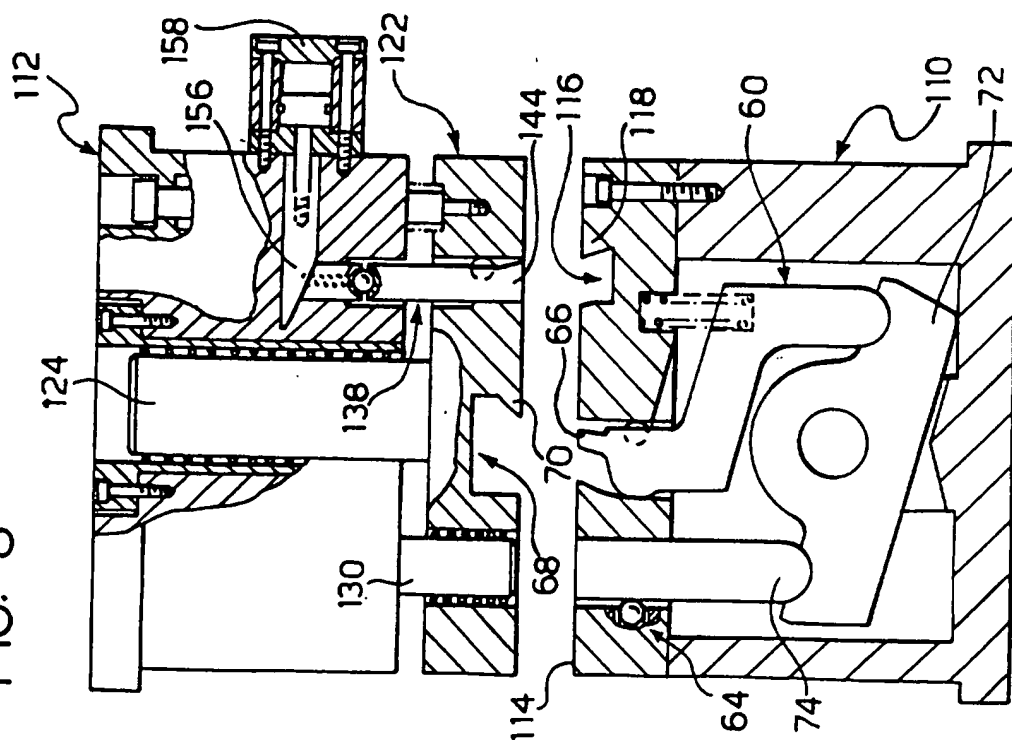


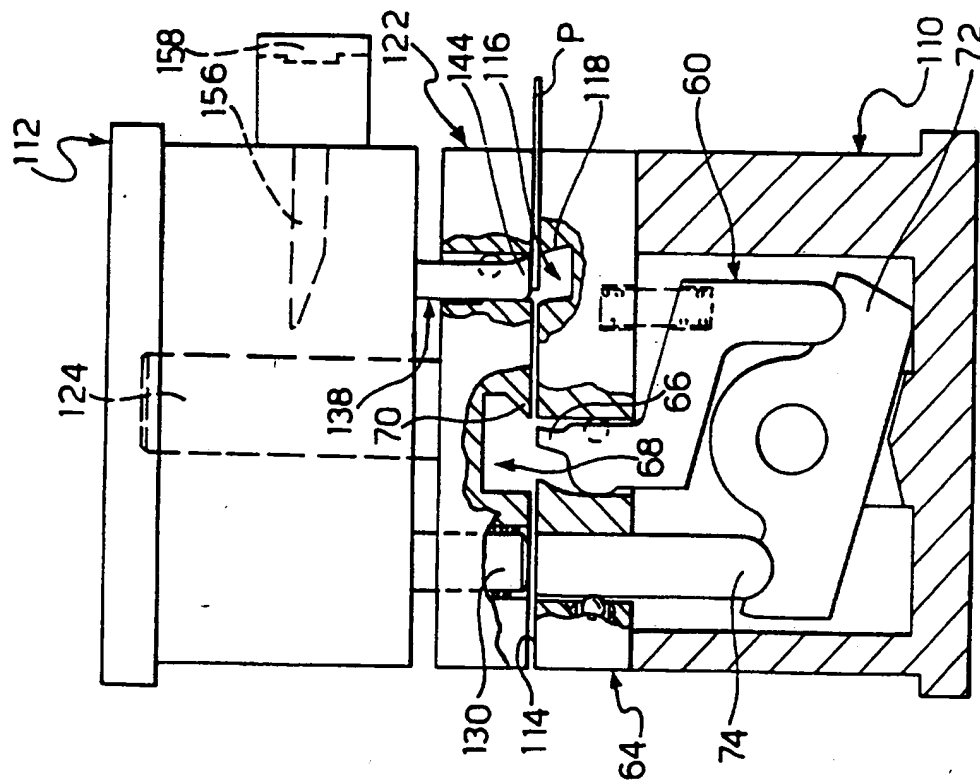
FIG. 7



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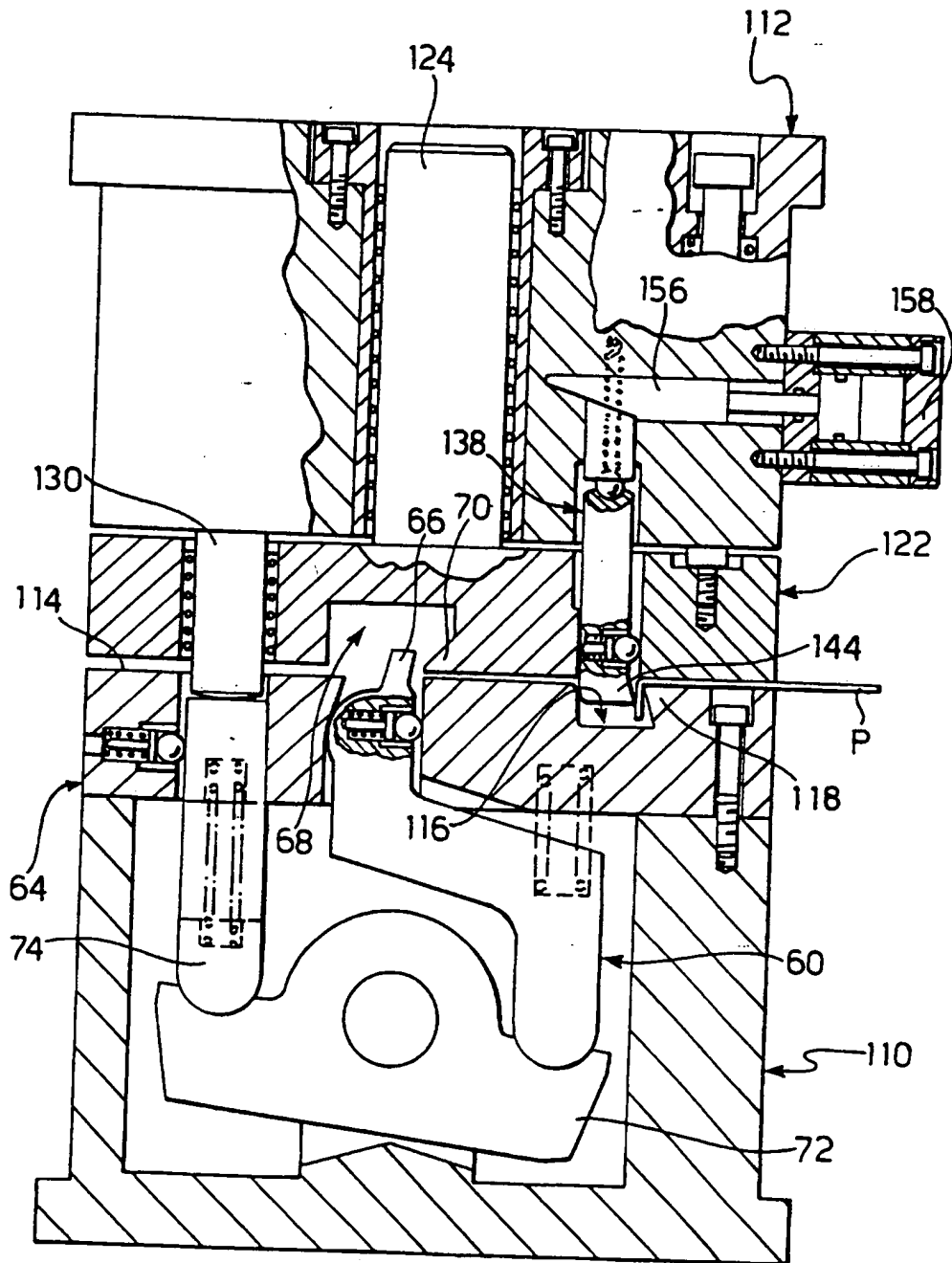


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FIG. 10



INTERNATIONAL SEARCH REPORT

International application No.

PCT/EP 96/00435

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: B21D 5/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: B21D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP, A2, 0293964 (SALVAGNINI TRANSFERICA S.P.A.), 7 December 1988 (07.12.88), figure 1, abstract --	1-8
A	EP, A2, 0298056 (CODATTO, ANTONIO), 4 January 1989 (04.01.89), figures 4-5 --	1-8
A	EP, A1, 0490828 (SAMAT S.R.L.), 17 June 1992 (17.06.92), figure 1, abstract --	1-8
A	US, A, 4455857 (SALVAGNINI), 26 June 1984 (26.06.84), figure 1, abstract --	1-8

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US, A, 4722214 (HAYASHI ET AL), 2 February 1988 (02.02.88), figure 5 --	1-8
A	US, A, 4783984 (ASCHAUER), 15 November 1988 (15.11.88), figure 1, abstract -- -----	1-8

SA 1991

INTERNATIONAL SEARCH REPORT

Information on patent family members

01/04/96

International application No.

PCT/EP 96/00435

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